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NODULAR WORM DISEASE OF SHEEP



Leaflet No. 228

U. S. DEPARTMENT of AGRICULTURE

CASINGS FOR SURGICAL SUTURES

In time of war the loss of meat and wool and of intestines from which to make casings and surgical sutures becomes doubly serious because of the greatly increased demand for all these products and difficulties in obtaining them from other sheep-raising countries.

The Department of Agriculture has recently been advised of a serious shortage in the supply of suitable sheep casings from which to manufacture the high-quality, absorbable sutures used by surgeons in closing wounds and for ligatures. The shortage is due to the curtailment in shipping facilities and disturbed conditions in foreign countries from which supplies of suitable casings are normally obtained. The United States has depended on imports to a large extent because of an inadequate supply of sound domestic sheep casings.

The great demand for sutures for supplying the United Nations, the armed forces of the United States, and civilian needs makes it desirable to combat nodular worm disease with the utmost energy. Sheep raisers have the opportunity and responsibility, therefore, of making a distinct contribution to the Nation's war efforts by eradicating nodular worms from their flocks and thereby preventing further inroads of this parasite. By so doing farmers will be safeguarding and increasing the supply of a raw product (nodule-free sheep intestines) which is urgently needed for the production of this vitally important material. At the same time they will be increasing the output and quality of wool, lamb, and mutton, and assuring for themselves dividends in the form of better prices and profits.

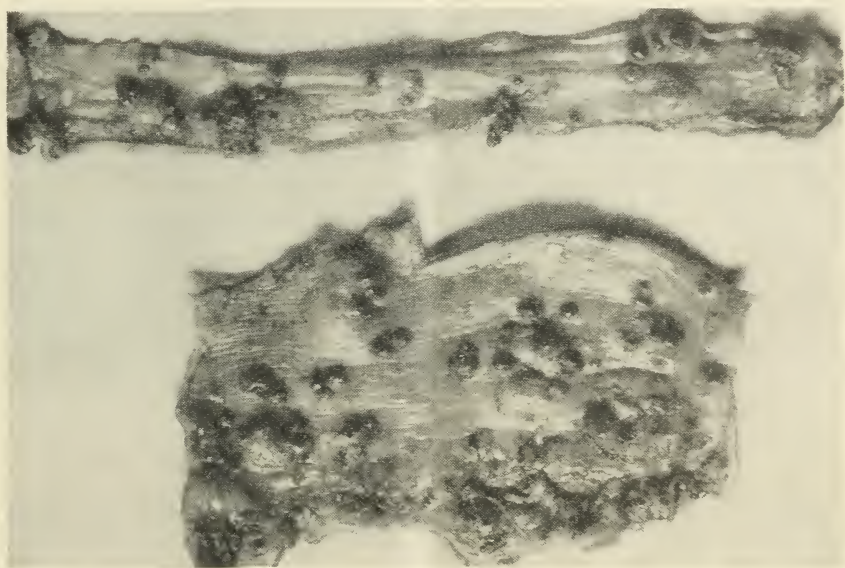
This leaflet shows how nodular worms may be controlled and eradicated.

NODULAR WORM DISEASE OF SHEEP

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One of the most damaging parasites of sheep is the nodular worm, so named because it causes abscesslike swellings or nodules in the wall of the intestines, and produces the condition called nodular disease, pimply gut, or knotty gut.

Nodular disease is responsible for serious losses to the meat industry and to sheep raisers. The formation of nodules and gritty masses in



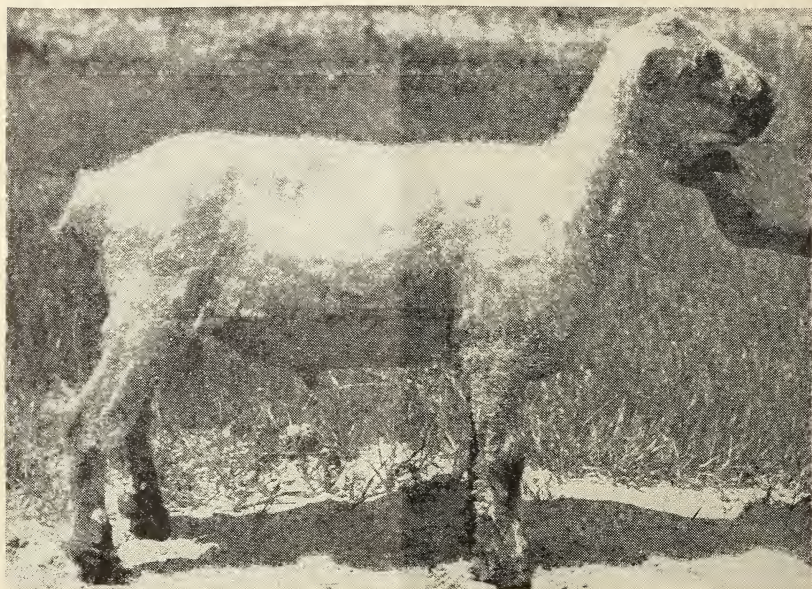
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FIGURE 1.—Typical nodules on the outer surface of sheep intestines, caused by nodular worms. Section of small intestines is shown above, and of the large intestine below. In both cases the nodules are old and calcified making the casing unfit for use as surgical sutures. About half natural size.

the intestinal wall causes direct loss by rendering the intestines unfit for sausage casings or for the manufacture of surgical sutures (fig. 1). Livers from infected sheep are frequently condemned in whole or in part because of the presence of similar nodules. Loss of casings has been estimated to amount to from \$500,000 to \$700,000 a year in one State alone, and to several million dollars a year for the entire country. The indirect losses resulting from the undermining of the health of sheep by nodular worms are less obvious but are probably equally large.

Sheep which are lightly infested may act as carriers or spreaders of the parasite without exhibiting any symptoms, but those that have become more heavily infested lose weight and finish and fail to grow and gain weight normally even when well fed (figs. 2, 3, and 4). They

also become stunted and produce less wool, and wool of poorer quality. Some infested sheep die of the disease or from its complications, and others decrease in value for breeding, wool production, and meat (cover page).



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FIGURE 2.—A lamb 58 weeks old showing stunted and emaciated condition resulting from heavy infestation with nodular worms. Compare with healthy lamb of the same age shown in figure 3.

Distribution

Nodular disease is a serious problem in many sheep-raising areas throughout the world. In some places the losses caused by this disease are reported to have been so great as to have caused the abandonment of sheep raising. Nodular disease is common in farm flocks in the United States, being especially prevalent in the Southern and Eastern States, although it is spreading westward and has become troublesome in the Midwestern and some Southwestern States.

Life History

The adult, crook-shaped worms are about half an inch long and are found unattached in the upper part of the large intestine. The infective larvae—small, immature worms—develop in about a week from eggs passed in the manure. Sheep become infected by eating grass upon which these larvae have crawled. After being swallowed the worms develop for a few days in the wall of the intestines and complete their growth to the egg-laying stage in the large intestine in about 35 days.

Types of Injury

Worms which fail to escape from the intestinal wall cause the development of the persistent nodules which are characteristic of the disease. Ordinarily, the development of nodules is a cumulative

process throughout the life of an animal. These nodules often reach the size of a large pea and contain a green, cheesy material, or a brown, gritty mass. When present in large numbers the nodules cause great thickening and constriction of the wall of the intestines. Some of the worms eventually break out of the nodules into the intestine, leaving ulcers; others wander into the abdominal cavity producing nodules in the abdominal organs and sometimes causing peritonitis and adhesions.



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FIGURE 3.—Healthy lamb of the same age and fed the same ration as the worm-infested lamb shown in figure 2. Note excellent development and finish.

The worms irritate the large intestine, causing it to become thickened and reddened; secretion of mucus is stimulated, and the dung may become soft or even liquid.

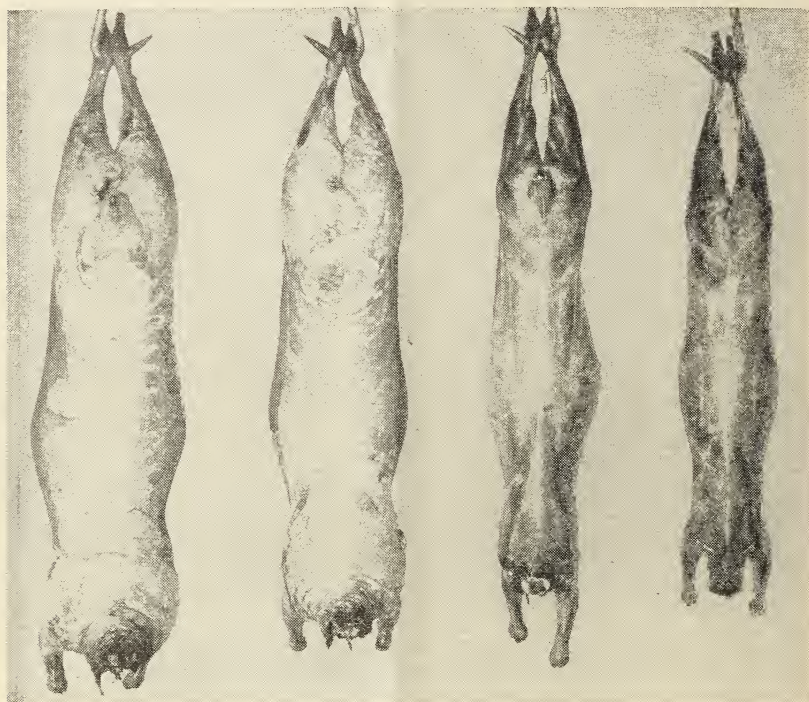
Symptoms

Sheep harboring small numbers of worms and nodules may show no symptoms, but when large numbers are present the dung becomes soft and the sheep may lose weight slightly or gain less rapidly than formerly. In severely infected sheep, marked stunting takes place; the wool becomes dry and yellow, and may show a distinct break; there is a marked loss of weight leading to extreme emaciation; chronic diarrhea develops causing great soiling of the wool; later the passing of dung becomes painful and is associated with straining and a characteristic hunched-up posture; the sheep become dull, inactive, and weak; and loss of appetite may occur. Despite the severity of the disease animals may survive this acute stage and show gradual disappearance of the most marked symptoms although still suffering chronically from the effects of a greatly thickened and nodule-studded intestine.

Diagnosis

Occurrence of the symptoms described above, especially in the fall and winter, definitely suggests the presence of nodular disease. The

infection can sometimes be diagnosed in the living animal by finding the pea-sized, firmly embedded nodules by gentle exploration of the wall of the rectum with the finger. The presence of even light infections in flocks may be easily demonstrated after slaughter by finding the characteristic nodules or gritty masses in the walls of the intestines,



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FIGURE 4.—A contrast in lamb carcasses, illustrating the effect of nodular worms. The two carcasses at left are those of lambs that were free of nodular worms. Note normal development of muscle and fat. The two at right illustrate the effect of heavy infestation with nodular worms. Note poor development and practical absence of fat. The lambs were all of approximately the same age and received the same ration.

or by finding the adult worms on the lining of the large intestine. Microscopic identification of the eggs of the nodular worm in the dung is difficult.

Treatment

Treatment is essential to the control of nodular disease but it is not a cure. Young worms that are in the nodules of the small and large intestines are beyond the reach of drugs, and there is no treatment that can effectively remove the nodules which already exist. Although the results of treatment, therefore, are not so evident as they are in most other kinds of parasitism, removal of the adult nodular worms affords some immediate benefit to diseased sheep and also helps to prevent more serious disease in these and other animals by reducing the risks of infection.

Phenothiazine is effective for the removal of adult nodular worms from the large intestine and has the added advantage of effective

action against most of the other economically important roundworm parasites of sheep. The dose for adult sheep is 25 grams or approximately 1 ounce. For lambs weighing less than 60 pounds, 15 grams is generally adequate. It may be administered in capsules, in feed, or in the form of a drench and should be given under the supervision of a veterinarian. A satisfactory suspension for use as a drench can be prepared by thoroughly mixing 25 grams of the drug with 15 cc. ($\frac{1}{2}$ fluid ounce) of molasses and then mixing this with enough warm water to make about 45 cc. or $1\frac{1}{2}$ ounces. Many proprietary products containing phenothiazine are specifically designed for use as drenches or as prepared capsules; these should be used according to the directions accompanying them. The administration of phenothiazine in feed appeals to flock owners because of its relative simplicity and greater economy, and, in limited trials, this method of treatment has proved to be safe and especially well adapted for worming pregnant ewes. Only a few animals should be treated in one group and they should be sufficiently hungry to consume the medicated feed in from a few hours to a day. The following formula has been used for treating sheep in groups of five:

Phenothiazine.....	125 grams (about $4\frac{1}{2}$ ounces).
Molasses.....	125 cc. (about 4 fluid ounces).
Water.....	100 cc. (about 3 fluid ounces).
Mixed grain feed.....	4 pounds.

A simpler mixture, involving the addition of the drug directly to moistened grain, has also been used with good results. In this case it may be necessary to use a slightly larger amount of feed. Thorough mixing is essential. There should be available at the trough sufficient space for all animals to feed at the same time. Sheep varying greatly in size should not be treated together. Weak animals should be treated separately, or watched to make sure that they are consuming enough of the medicated mixture. There should be access to water at all times.

No serious symptoms have been reported in sheep following treatment with phenothiazine. Some of the drug is excreted as a dye in the urine, causing the latter to turn red on exposure to the air. To minimize staining of the wool, treated sheep may be kept for a few days on thick bedding or on the ground where the urine will be absorbed quickly. There is no evidence, however, that the stain affects the value of the fleece and under ordinary circumstances it disappears after a month or so.

Control

The practical prevention of nodular disease can be achieved in greatest measure by timely treatment with phenothiazine¹ in conjunction with pasture hygiene and general sanitation. Sheep raised in Northern States are afforded considerable natural protection against parasitism since pasture contamination drops to insignificant levels during the long, hard winters. Evidence indicates that no infective larvae of nodular worms survive on unused pastures during moderately severe winters. Between seasons, therefore, the infection

¹ As diphenylamine, one of the ingredients of phenothiazine, is a strategic material used in the production of munitions, it is possible that in time of war adequate quantities of this substance may not be obtainable for making enough phenothiazine to treat animals for the removal of intestinal parasites. Under such conditions a fair degree of control of nodular disease may be accomplished by careful selection and rotation of pastures as described in the text.

is carried over in the breeding stock. The ewe is the first and most dangerous source of infection to the young lamb. She should be treated at least once, preferably twice with an interval of a month between treatments, in order to remove as many of the parasites as possible. So far as practicable, supplementary measures of sanitation should be employed to enhance the efficacy of the control program. The premises and stalls where the lambs are dropped should be clean. Ewes and their lambs are indoors, manure should be removed from the pens twice weekly. The greatest number of adult worms is present in the intestines of sheep in early spring—presumably the result of the continued emergence of larvae from nodules during the first four months or so following the previous grazing season. The intervention of an efficient anthelmintic to remove adult worms from breeding stock immediately before each grazing season should, therefore, result in a high measure of protection to the young stock. If only one treatment were to be given each year, this would be, theoretically, the most strategic time to give it. Moreover, if ewes and their lambs are kept indoors during the winter, the same pastures may be used again in the spring without significant risk to the lambs. The introduction of parasitized animals into this flock should be guarded against. Newly purchased animals and those that have not been effectively treated for the removal of their worms must not be put into the flock until they have been treated and about a week has elapsed to permit the loss of the worms expelled by the drug.

Unfortunately, these measures may not always be wholly effective; treatments, for example, usually do not remove all of the nodular worms in an animal. There is, therefore, in every flock the possibility of a small residual infection which is a potential source of severe disease unless other measures are employed. Risks from this source of danger can be reduced by shifting the flock to a new pasture before the old one has become heavily contaminated.

In general it is desirable to move sheep to fresh pastures as often as feasible, and if possible to allow the pasture at least a 2-month rest during which most of the parasites on the pasture will have died. One change of pastures in midsummer, may be sufficient, although flocks in which infection with stomach worms or trichostrongyles has presented a serious problem, may require a change to new pasture more frequently. The old pasture may be used for other animals (except cattle and goats) or it may be rested. From the standpoint of the parasite problem, it matters little which method is followed; this must be determined by the management problems of the individual farm.

In northerly areas it may be sufficient to treat the ewes only once or twice during the winter before the lambs are dropped and again in spring before the flock is put out to pasture. This limited number of treatments, however, would be inadequate in warmer climates where sheep are grazed throughout the year. Under these latter conditions, additional treatments should be given once or twice during the summer and, if possible, the flock should be transferred to new pastures after treatment. In areas where stomach worm disease is also present it may be necessary to treat more often during the warm months; in such cases the standard copper sulfate drench is the cheapest, most effective interim treatment that can be used.

